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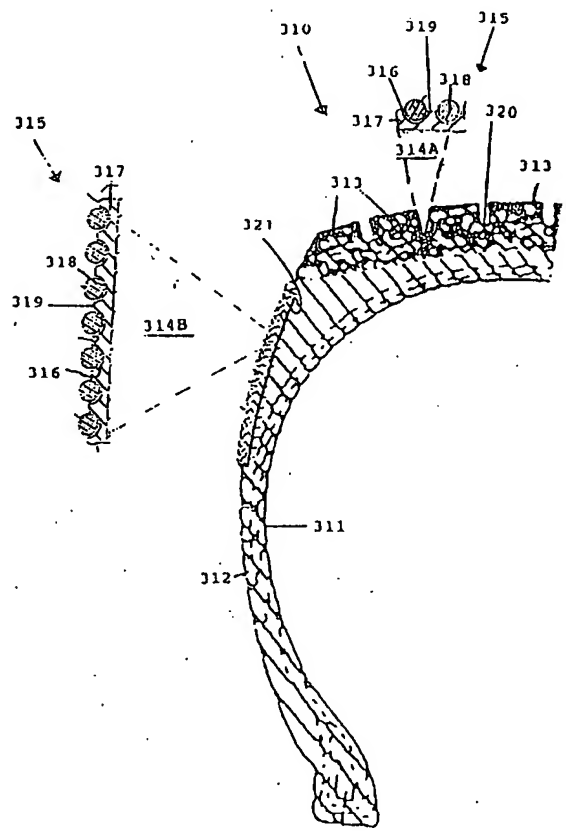
(54) **PNEUS DE BICYCLETTE A SURFACES RETROREFLECHISSANTES**

(54) **BICYCLE TIRES HAVING RETROFLECTIVE SURFACES**



(57) Pneu de bicyclette innovateur comportant une couche de billes rétroréfléchissantes qui adhèrent en permanence à la paroi latérale près de la bande de roulement du pneu et/ou à la base des rainures que comporte la bande de roulement du pneu.

(57) A novel bicycle tire is provided herein having a layer of retroreflective beads permanently adhered onto or into, the sidewalls adjacent the tread portion of the tire and/or the bases of grooves forming the tread portion of the tire.

ABSTRACT

A novel bicycle tire is provided herein having a layer of retroreflective beads permanently adhered onto or into, the sidewalls adjacent the tread portion of the tire and/or the bases of grooves forming the tread portion of the tire.

1) Title of the Invention

Bicycle Tires Having Retroreflective Surfaces

2) Background of the Invention

(a) Field of the Invention

This invention relates to articles which have retroreflective surface in order to provide greater safety at night. Among the articles embraced by the present invention are: tires, e.g., automobile tires, truck tires, aviation tires and bicycle tires; pet, i.e., dog and cat, collars; and leashes for dogs.

(b) Description of the Prior Art

Various reflectors have been mounted on automobile bodies, truck bodies, airplane landing gears, and hub caps as well as on bicycle fenders, handle bars, and other parts of a bicycle. Such reflectors have been adopted to meet purposes of both safety and attractiveness. However, it would be desirable to provide side reflex illumination so as to provide protection to the user of the bicycle. It will be appreciated that the best location for providing side marker illuminations is one or both bicycle wheels.

In the vehicle wheel cover or hubcap field, the prior art has consistently considered the hubcap as functional only when applied to the wheel of a vehicle. Suggestions have been made for the use of light reflective means on the outside of such hubcaps but such suggestions and proposals have not met with widespread commercial usage probably due to the limited aesthetic appeal. Moreover, light reflective surfaces on the outside of a hub

cap are frequently nonfunctional due to the grime which often covers hubcaps in normal usage.

Automobile headlamps are often recessed into the fenders of a car and are designed to send their beams essentially straight ahead. Likewise taillights are constructed with lenses which serve to send their beams directly backwards from the car. For this reason the lights of a car often cannot be adequately seen when approaching the side of the car at night.

Retroreflective materials are widely used in a variety of situations involving vehicle and pedestrian traffic. Retroreflective materials promote safety by improving the visibility of objects illuminated by vehicle headlights or other sources of light. In one such application, the circumference of both of the spoked wheels or tires of a bicycle are retroreflective. The retroreflective image of two circles separated by a fixed distance is quite recognizable as a bicycle, even if the other portions of the bicycle are not retroreflective. Unless viewed perpendicularly to the wheel, the circles are seen as ellipses, but the image is still recognizable as a bicycle.

Bicycle tires with retroreflective sidewalls are more expensive than conventional tires, and require replacement of existing non-retroreflective tires. Accordingly, products suitable for addition to bicycles with conventional tires have been developed.

Retroreflective materials generally have confined angularity, i.e., they brightly reflect light only within a narrow range of solid angles around a ray of incoming light. In many applications this is not a serious disadvantage, because the retroreflective material may be designed and placed so that the

intended observers are always within the preferred narrow angular range. For example many retroreflective materials are designed to retroreflective rays which lie very nearly on the line normal to the surface of the material. Traffic signs made with such materials may be placed to retroreflective light to the known positions of vehicles on a roadway. Bicycles, by contrast, may be travelling in a variety of directions when in the field of view of an observer. Thus, the circular image should be visible from all angles, including directly ahead of and behind the bicycle. The shapes of bicycle reflectors have been designed to complement the properties of retroreflective materials and thereby improve the visibility of the reflectors from all angles.

Nevertheless, patents have been provided which purported to solve this problem. For example, U.S. Patent No. 3,639,036 patented February 1, 1972 by E.J. Rosebach, Jr. disclosed a conventional vehicle hubcap which was provided on its inside surface with a light reflective means so that, when the hubcap was detached from its normal operative position on a vehicle, it could act as a light-reflecting safety device.

U.S. Patent No. 3,781,082 patented December 25, 1973 by H. Linden disclosed side reflectors mountable between adjacent spokes of a bicycle wheel, each reflector having an observe side with a reflector element and a reverse side with frictional locking tabs formed at opposite ends. Closely dimensioned locking spaces are between the tabs and the reverse side of the plate so that adjacent bicycle spokes may be captured within the spaces. The adjacent spokes urged portions of the locking tabs away from the reverse side

of the plate, and thereby assumed frictional locking engagement with the reflector.

U.S. Patent No. 4,194,810 patented March 25, 1980 by D.E. Eillor disclosed a reflector which was attached to the rim of a wheeled vehicle and revolved about the center of the wheel, thus following an eccentric path when the vehicle travelled in a straight path. The reflector had one surface which was substantially parallel to the plane of the wheel and another surface which extended transversely of that plane.

U.S. Patent No. 4,943,139 patented July 24, 1990 by C.A. Bacon et al provided a spoked wheel reflector employing encapsulated retroreflective tubing. the retroreflective microspheres attached to an outer surface of the core material, and a protective encapsulating material surrounding the microspheres.

U.S. Patent no. 5,155,626 patented October 13, 1992 by W. Lester disclosed a passive reflective safety device for vehicles formed as a wheel cover, in the form of a fixed applique to the outside of the vehicle body. A fixed geometric shape was attached to a rotational part of the vehicle or to a rotating wind driven vane attached to the vehicle. Each of the devices functioned as a passive beacon to alert persons in other vehicles of the presence of the user's vehicle. Each device was fabricated as a rigid sheet material with a reflective layer applied to a visible side of the device.

Tires having retroreflective strips adhered to their sidewalls have found acceptance, particularly for use on bicycles and motorcycles to provide a measure of safety when the cycle is operated after dark. Such tires are

typically constructed by adhering parallel strips of an uncured elastomer, e.g., neoprene rubber supporting a layer of retroreflective elements to an unvulcanized tire casing at a position remote from the tire tread. The tire casing is then vulcanized in a tire mold to form a completed tire having a U-shaped cross-section with the strips supporting the retroreflective elements forming a unified or integral part of the vulcanized tire casing.

Other patents and publications provided tires having decorative or reflective appliques on or in the sidewalls.

U.S. Patent No. 3,382,908 patented May 14, 1968 by P.V. Palmequist et al provided a tire having a monolayer of reflex-reflective elements partially embedded in an outside sidewall remote from the tire treads to provide a night-time signal of the location or movement of the tire. The patent provided a teaching of the use of thin sheet materials comprising an elastomeric support layer with a monolayer of retroreflective elements embedded therein. The support laye was a vulcanized elastometer which was compatible with the elastomer of the tire sidewall.

In the pneumatic tires that had reflex light reflective exterior sidewall portions remote from the tire tread, a layer of reflex-reflective elements was supported on the tire sidewall remote from the tire tread. When in place on a vehicle and illuminated by oncoming traffic at nigh time, those tires provided a bright, cone-shaped, substantially-coaxial reflection of light back to the source of illumination, with sufficient spreading of the cone of returned light to make the tire visible to drivers of the oncoming vehicles.

The patented reflex-reflective pneumatic tires were said to be capable of rugged wear without substantial deterioration of their reflective properties. Because of the location of the reflective portion on the tires, it was said to withstand abrasion by curbs and severe and repeated flexure by travel over uneven roadways, and was not degraded in severe weather conditions. The reflective tire sidewall portion had similar elastomeric properties as the rest of the sidewall so that the tires functioned as they would without a reflective treatment. In addition, no point at which destructive forces might develop was built into the tires. The reflective area was located and shaped precisely on the sidewalls of the tires remote from the tread, making the appearance of the tires aesthetically satisfying and the treatment practicable.

One way of providing such tire casing to which at least one transfer sheet assembly bearing a layer of reflex-reflective elements was strongly adhered as taught by this patentee, was during the tire making process. The transfer sheet assembly included an elastomeric support sheet, on the front side of which reflex-reflective elements were partially embedded and permanently bonded, and a flexible cover sheet releasably adhered to the support sheet over the protruding elements. The cover sheet remained releasable even after being subjected to heat and high pressure against the support sheet. The back outside layer of the support sheet included a vulcanized elastomeric material that was compatible with tire sidewall elastomers. Under heat and pressure, the backing formed a strong bond therewith. The front portion of the sheet in which the reflective elements

were embedded included material having strong adhesion to the material of the elements.

In the tire mold, the tire casing was shaped around the transfer sheet assembly which had been placed remote from the tire treads, with the support sheet being vulcanized as the casing was vulcanized and forming an integral part of the tire sidewall. After removal of the tire from the mold, the cover sheet was peeled back to reveal a reflex-reflective area having the shape established by the dimensions of the sheet assembly.

U.S. Patent No. 3,449,201 patented June 10, 1965 by P.V. Palmiquist et al provided sheet material comprising an elastomeric support sheet and reflex-reflective elements partially embedded in the support sheet. The back outer stratum of the sheet included a vulcanizable elastomer. The elements were embedded in an organic compound having oxirane functionality and a poly (tetramethyleneoxide) diamine that was a curing agent for the oxirane compound. Such sheet material was used as a decorative tire facing. The novel sidewall facings could be applied in a short time by the service personnel of a retail tire operation to the tire sidewalls remote from the tread.

The patentee also taught the incorporation of such facings into tires during the tire building operation at the tire factory.

The tire sidewall was thus made reflex-reflective at portions remote from the tire treads. When in place on a vehicle and illuminated by oncoming traffic at nighttime, these tires provided a bright, cone-shaped, substantially coaxial reflection of light back to the source of illumination, with sufficient

spreading of the cone of returned light to make it visible to drivers of the oncoming vehicles.

U.S. Patent No. 4,256,159 patented March 17, 1981 by J.H. Milbers provided a tire applique comprising a laminate material of first, second and third layers. The first layer was a vulcanizable rubber latex coating or other elastomer. The second layer was a stamping material secured to the first layer. The third layer was a data material hot stamped to the second layer. the tire applique was vulcanized or other wise adhered to a tire sidewall surface to provide identification material for the tire.

U.S. Patent No. 5,055,347 patented October 8, 1991 by C.A. Bacon provided a retroreflective sheeting comprising a monolayer of retroreflective elements partially embedded in an elastomeric support layer and protruding from the front side of said support layer, and an omni-directionally elastic filamentary reinforcing web at least partially embedded in the rear portion of support layer. the back stratum of the support layer was a vulcanizable or curable elastomer which formed a strong bond to rubber when simultaneously cured with rubber.

The patentee also taught how to bind such sheeting to a rubber article, e.g., to the sidewall of a tire. As taught, a piece of the sheeting was cut to appropriate dimension and was placed on the proper location on the unvulcanized or green tire casing remote from the tread, with the rear side of the support layer in contact with the tire casing. This assembly was then put into the tire mold for vulcanization.

When heat and pressure were applied, the tire casing was shaped and cured and the sheeting was bonded to, and partially embedded in, the surface thereof. The vulcanizable portion of the support layer vulcanized with the elastomer of the tire sidewall such that the sheeting formed a substantially-integral part of the tire sidewall.

3.) Summary of the Invention

(a) Aims of the Invention

The main deficiency of many of these devices is that they are "add-on" devices either to the wheel, to the rim of the wheel, to the spokes of a bicycle wheel or to the hubcap. In the case of pet collars or leashes, they wee also "add-on" reflective beads. It would be advisable to provide reflective surfaces directly in, or on, the respective articles.

In the case of retroreflective sheets vulcanized or adhered t the tire, they were always applied to the sidewall remote from the tread, and thus became "invisible" to a vehicle approaching from a direction parallel to the direction of travel of the bicycle.

Accordingly, one object of this invention is the provision of a bicycle tire in which a retroreflective surface is integral with the tire and is visible regardless of the angle of incidence of a tire to the direction of travel of the headlight of a vehicle.

Another object of this invention is the provision of a pet collar provided with retroreflective surfaces which are integral with or blended into the collar.

Yet another object of this invention is the provision of a pet leash or harness provided with retroreflective surfaces which are integral with or blended into the pet leash or harness.

(b) Statement of Invention

The present invention is directed to the concept of the use of retroreflective beads vulcanized onto or into the outer surface of the article, i.e., the various types of tires, or the pet collar, or the pet leash.

In the case of a tire, the retroreflective beads are vulcanized onto, or into the sidewall of an elastomeric tire adjacent to the treads of the tire and/or the base of the grooves forming the treads of an elastomeric tire. Thus, the present invention provides, as one embodiment, a bicycle tire having a layer of retroreflective beads permanently adhered, as by vulcanization, onto or into, the sidewall of an elastomeric tire adjacent to the treads of the tire and/or the bases of grooves forming the tread portion thereof. The term "elastomer" as used herein, includes natural and synthetic rubbers, as well as polymeric materials exhibiting the major characteristics of rubber including resilience, elongation, abrasion resistance, curing of vulcanizing properties, and the like, which render the same useful for tires.

The invention also provides as another embodiment, a collar, leash or harness comprising a base article having a rectangular cross-section belt form or having a circular cross-section cylindrical form, and layer of retroreflective beads permanently adhered thereto, or blended into, by vulcanization or adhesion, onto or in, at least the outer exposed surface of the collar, leash or harness.

(c) Further Features of the Invention

By one feature of the bicycle tire of this invention the retroreflective beads are permanently adhered to the tire by vulcanization, and by another feature of the bicycle of this invention, the retroreflective beads are permanently adhered to the tire by adhesion.

By another feature of the bicycle tire of this invention, the bases of the grooves forming the tread portion of the tire are provided with a sheeting material, the sheeting material having a base amendable to securement to an elastomer by vulcanization, and having another surface provided with durable, exposed, retroreflective beads, the so-provided combination having been subjected to vulcanization, the retroreflective beads thereby being vulcanized onto or into the bases of the grooves forming the tread.

By yet another feature of the bicycle tire of this invention, the bases of the grooves forming the tread portion of the tire are provided with an adherent coating of a formable material provided with the retroreflective beads therein, the tire then having been treated to integrate the formable material with the base of the tire tread and the sidewall, the reflective beads thereby being vulcanized onto or into the bases of the grooves forming the tire treads.

By another feature of the bicycle tire of this invention, the side walls of the tire adjacent to the tread portion of the tire are provided with a sheeting material, the sheeting material having a base amendable to securement to an elastomer by vulcanization, and having another surface provided with durable, exposed, retroreflective beads, the so-provided combination having been

subjected to vulcanization, the retroreflective beads thereby being vulcanized onto, or into, the side walls of the tire adjacent to the treads.

By yet another feature of the bicycle tire of this invention, the side walls of the tire adjacent to the tread portion of the tire are provided with and adherent coating of a formable material provided with the retroreflective beads therein, the tire then having been treated to integrate the formable material with the sidewalls, the reflective beads thereby being vulcanized onto, or into, the sidewalls of the tire adjacent to the treads.

By another feature of the bicycle tire of this invention, both the sidewalls of the tire adjacent to the treads and the bases of the grooves forming the tread portion of the tire are provided with a sheeting material, the sheeting material having a base amendable to securement to an elastomer by vulcanization, and having another surface provided with durable, exposed retroreflective beads, the so-provided combination having been subjected to vulcanization, the retroreflective beads thereby being vulcanized onto or into both the sidewalls of the tire adjacent to the tread and the bases of the grooves forming the treads.

By yet another feature of the bicycle tire of this invention, both the sidewalls of the tire adjacent to the treads and the bases of the grooves forming the tread portion of the tire are provided with an adherent coating of a formable material provided with the retroreflective beads therein, the tire then having been treated to integrate the formable material with the base of the tire tread and with the sidewalls, the reflective beads thereby being vulcanized

onto or into both the sidewalls of the tire adjacent the treads and the bases of the grooves forming the tire treads.

In the case of a pet collar, the outer surface of the belt forming the pet collar, the ends of which are provided with clasping means to provide an encircling collar, is provided with retroreflective beads, which are adhered to or blended into the outer surface of the belt.

In the case of a pet leash, at least one, and preferably both, surfaces of a flat belt leash or harness or the entire outer surface of a circular (in cross-section) leash or harness are provided with retroreflective beads which are adhered to or are blended into such surfaces.

By a feature of a pet collar of this invention, at least one surface of the belt form, the ends of which are provided with clasping means to provide and encircling collar, is provided with retroreflective beads, the beads being permanently adhered onto or into or are blended into, the outer surface of the belt form which provides the pet collar.

By another feature of the pet collar of this invention, the at least one outer surface of the collar has been modified by the application, to the outer surface thereof, of an adherent coating which is amenable to treatment to provide permanent bonding; wherein a retroreflective bead flexible film has been adhered thereto, the film being a flexible film having a base surface amenable to securement to provide permanent bonding, and whose other surface is provided with durable, exposed, retroreflective beads; and wherein upon completion of the treatment to provide permanent bonding, the

retroreflective beads have been permanently bonded onto or into or are blended into the collar.

By yet another feature of the pet collar of this invention, the at least one outer surface of the collar has been coated with a liquid or viscous coating composition containing the retroreflective beads; and wherein upon completion of the drying of the coating composition, the retroreflective beads have been permanently bonded onto or into or blended into the collar.

By a feature of the pet leash or harness of this invention the entire outer surface of the circular in cross-section leash or harness is provided with retroreflective beads which are permanently adhered onto, or into, or are blended into, the surfaces.

By another feature of the pet lease or harness of this invention, the outer surface of the leash or harness has been modified by the application to the outer surface thereof, of an adherent coating which is amenable to treatment to provide permanent bonding; wherein a retroreflective bead flexible film has been adhered thereto, the film being a flexible film having a base surface amenable to securement to provide permanent bonding, and whose other surface is provided with durable, exposed, retroreflective beads; and wherein upon completion of the treatment to provide permanent bonding, the retroreflective beads have been permanently bonded onto or into or blended into the leash or harness.

By still another feature of the pet leash or harness of this invention, the outer surface of the leash or harness has been coated with a liquid or viscous coating composition containing the retroreflective beads; and wherein upon

completion of the drying of the coating composition, the retroreflective beads have been permanently bonded onto or into or blended into the collar.

(d) Generic Description of the Invention

In the manufacture of tires, layers of tire carcasses are assembled on the cylindrical surface of a tire building are assembled on the cylindrical surface of a tire building drum. the layers of tire carcasses are then removed to be formed into tires which are then vulcanized. By this invention, a bicycle tire is provided in which the layers of the tire carcasses which are provided wherein the retroreflective beads have been applied to the sidewalls and/or to the base of the treads. Before these carcasses are vulcanized, a flexible film having a base surface amenable to securement to an elastomer by vulcanization, and whose other surface is provided with durable, exposed, retroreflective lenses, is adhered to what is to become the sidewall adjacent the tire treads and/or the tread portions of the tire. Upon completion of the vulcanization, the retroreflective beads are vulcanized onto or into the sidewalls adjacent the tire treads and/or the tire treads. Because of the location of the retroreflective beads, a bicycle tire is visible at night regardless of the angle of incidence of the bicycle to a vehicle traveling on the road.

In the case of a pet collar, or harness the collar, or harness whatever material it is made of, is modified by the application to the outer surface thereof, of an adherent coating which is amenable to permanent bonding. Then a retroreflective bead-bearing film is adhered thereto. Such film is a flexible film having a base surface amenable to permanent bonding, and whose other surface is provided with durable, exposed, retroreflective lenses. Upon

completion of the bonding, the retroreflective beads are permanently adhered onto or into or blended into the collar or harness.

In the case of a pet leash, or harness, the structure will depend on the cross-section of the leash or harness. In the case of a rectangular cross-section, the leash or harness whatever material it is made of, is modified by the application to the outer surface thereof, of an adherent coating which is amenable to permanent bonding. Then a retroreflective bead flexible film is adhered thereto. Such film is a flexible film having a base surface amenable to permanent bonding, and whose other surface is provided with durable, exposed, retroreflective lenses. Upon completion of the desired bonding, the retroreflective beads are permanently adhered onto or into blended into the leash.

4.) Brief Description of the Drawings

In the accompanying drawings,

Figure 1 shows a one-half cross-section of a bicycle tire with a blow-up enlargement showing retroreflective beads into or onto the sidewalls of the ire adjacent the tire tread;

Figure 2 shows a one-half cross-section of a bicycle tire with a blow-up enlargement showing the structure of the retroreflective beads at the base of the tire tread; and

Figure 3 shows a one-half cross-section of a bicycle tire with a blow-up enlargement showing retroreflective beads both into or onto the sidewalls of the tire adjacent the tire tread and with a blow-up

enlargement showing the structure of the retroreflective beads at the base of the tire tread.

5.) Description of Preferred Embodiments

(a) Description of Figure 1

As seen in Figure 1, the tire 100 consists of a tire sheeting 111 forming the sidewall 112. The tire 100 is provided with a plurality of treads 113. As seen in the blow-up portion 114, retroreflective elements 115 are partially embedded in binder layer 116 of support layer 117. The retroreflective elements 115 comprise microspheres 118, which protrude from front face 119 of support layer 117.

Blow-up portion 114 is inset into a portion 120 of the sidewall 112 adjacent the tread 113 although it can be disposed projecting from the sidewall 112.

(b) Description of Figure 2

As seen in Figure 2, the tire 210 consists of a tire sheeting 211 forming the sidewall 212. The tire 210 is provided with a plurality of treads 213. At the base of the grooves 220 forming the treads 213 are the retroreflective beads as shown in detail in the blow-up portion 214. As seen in the blow-up portion 214, retroreflective elements 215 are partially embedded in binder layer 216 of support layer 217. The retroreflective element 215 comprises microspheres 218, which protrude from front face 219 of support layer 217.

Blow-up portion 214 is disposed at the base of the grooves 220 forming the treads 213.

(c) Description of Figure 3

As seen in Figure 3, the tire 310 consists of a tire sheeting 311 forming the sidewall 312. The tire 310 is provided with a plurality of treads 313. At the base of the grooves 320 forming the treads 313 are the retroreflective beads as shown in detail in blow-up 314A. In addition, within a portion 321 of the sidewall 312 are the retroreflective beads, shown in detail in 314B. The retroreflective elements 315 are partially embedded in binder layer 316 of support layer 317. The retroreflective elements 315 comprise microspheres 318, which protrude from front face 319 of support layer 317.

Thus, sidewall 312 adjacent the tread 313 is provided with the retroreflective beads 315 , as being inset into a portion 321 of the sidewall 312, although it can project outwardly from sidewall 312. In addition the base of the grooves 320 forming the treads 313 is provided with the retroreflective beads 315.

(d) Generalized Description of the Invention

One suitable retroreflective sheeting which may be used in the practice of the present invention is that commercially available as SCOTCHLITE$_{TM}$ Reflective Tire Sheeting 8150, the trade-mark of Minnesota Mining and Manufacturing Company.

SCOTCHLITE$_{TM}$ Reflective Tire Sheeting 8150 is a flexible, durable, exposed lens retroreflective sheeting specifically designed by the manufacturer for vulcanization to bicycle tire sidewalls remote from the treads. The sheeting does not require a primer for vulcanization to bicycle tire sidewalls, and it exhibits good green track and vulcanization adhesion to compatible,

non-staining bicycle tire compounds. During the day, SCOTCHLITE$_{TM}$ 8150 sheeting appears silver-gray in color, and when viewed at wide entrance angles.

The table below states the minimum coefficient of (retroreflective) luminous intensity, R values for 50 lineal inches (127 cm)^2 of the reflective material [nominally 1875 inches (4.76 nn) wide] when measured accordingly to ASTM E-809, ofCIE Publication 54.

	Observation angle[4]	Enterance angle[7]		
		5°	20°	40°
R vallues in terms of Candlepower/foot-candle/50 lineal inches	0.2° 3.33° 1.5°	21.5 14.0 1.0	19.5 12.0 1.0	4.5 3.3 0.45
Candelas/lux/127 cm	0.2° 0.33° 1.5°	2.0 1.3 0.09	1.8 1.0 0.09	0.4 0.3 0.04

The following are the physical characteristics of SCOTCHLITE$_{TM}$ Reflective Tire Sheeting 8150.

Tensile Strength[5] - Minimum of 6.28 pounds per inch width (1.1N/mm) with liner removed when tested according the ASTM D412 or ISO 37.

Elongation - Minimum of 50% with liner removed when tested according to ASTM D412 or ISO 37. Flexibility and Adhesionn - With proper application and when vulcanized with proper mold temperature on a compatible bicycle tire sidewall, the sheeting will not bread during the molding of the tire use without releasing from the tire.

Another suitable such retroreflective sheeting is that disclosed and claimed in U.S. Patent No. 2,354,018 patented July 18, 1944 by Harry Heltzer and John Edmund Clarke, assignors to Minnesota Mining & Manufacturing Company. That patent provided a flexible waterproof light reflector sheet comprising a flexible water-resistant support including a flexible waterproof bead-bonding layer and a multiplicity of contiguous small

glass beads partially embedded therein. This formed a continuous surface layer. Light reflecting means are associated with the beads to produce, in combination therewith, a "reflexive" reflection of incident light, and an integral back coating of water-resistant adhesive.

Yet another suitable such sheeting is that disclosed and claimed in U.S. Patent No. 2,432,928 patented December 16, 1947 by Philop V. Palmquist, assignor to Minnesota Mining & Manufacturing Company. That patent provided a flexible transparent adhesive tape or sheet which is weatherproof and stretchy. The tape included a transparent, flexible. stretchy film backing, a transparent non-darkening and solar-hardening stretchy pressure-sensitive adhesive coating on one side thereof and on the other side a transparent, flexible, and stretchy bonding layer, and a layer of small transparent glass beads partially embedded in the bonding layer to provide a surface of contiguous convex lens elements.

Yet another such sheeting material is that disclosed and claimed in U.S. Patent No. 2,481,757 patented September 13, 1949 by Thoger G. Jungersen. That patent provided a flexible sheet reflector having indentations formed on one of its surfaces in accordance with the laws of optics to reflect light. Some of the indentations were formed to reflect light from the sky in a generally horizontal direction when the flexible sheet reflector was in a generally vertical plane, the indentations comprising inclined plane reflecting surfaces. A second set of indiemtations formed on the surface were designed to reflect light in the general direction of a second source of light so as to produce an autocollimating effect, the second set of indentations each

comprising three plane surfaces each of which are at right angles to the other. All of the indentations were of such relatively small size as compared with the outlines of the sheet that the general outlines of the sheet would not appear substantially disfigured to an observer at relatively close range. The reflecting units formed by the indentations were of sub design as to reflect substantially all the light transmitted to them from a light source.

Still another such sheeting material is that disclosed and claimed in U.S. Patent No. 3,005,382 patented October 24, 1961 by Victor Weber, assignor to Minnesota Mining and Manufacturing Company. That patent provided a flexible, light-transmitting, reflex-reflecting optical sheet heat-formable to shape as described and handlable as a discrete article, the sheet being transmissive to at least 5% and up to 50% of light directed upon its back surface and further being brilliantly reflex-reflecting of light directed upon its front face. The sheet includes a layer of reflex-reflecting complexes held in physical orientation in the sheet material by a flexible non-fibrous heat-formable light-transmitting binder. The complexes were minute sphere-lenses each in optical connection with an underlying specular-reflecting concentric cap on its back extremity away from the front face of the sheet material.

Still another such sheeting material is that disclosed and claimed in U.S. Patent No. 4,672,089 patented June 9, 1987 by Robert M. Pricone and William N. Roberts, assigned to Amerace Corporation. That patent provided a retroreflective, relatively-flexible, laminate sheet construction which had a thermoplastic web with a smooth light receiving first side and second side

coextensive with the first side. A retroreflective pattern was formed on the second side. A slurry of granular material was deposited on the second side to cover selected portions of the formed pattern with remaining portions of the formed pattern being devoid of the granular material. The slurry was dried or cured to produce a well-defined pattern. A layer of back coating material was deposited on the second side to overlay the granular material, the back coating material contacting the thermoplastic web where no granular material has been deposited. This encapsulated the granular material between the second side and the back coating layer. An added, outer layer provided additional weather protection for the thermoplastic web.

Still another sheeting material is that disclosed in U.S. Patent 5,055,347. The patented retroreflective sheeting comprising a monolayer of retroreflective elements partially embedded in an elastomeric support layer and protruding from the front side of the support layer, and an omni-directionally elastic filamentary reinforcing web at least partially embedded in the rear portion of the support layer, wherein at least the back stratum of the support layer is a vulcanizable or curable elastomer. The back stratum comprises an elastomer which is compatible with the desired substrate. The reinforcing web is typically a knit or nonwoven web. The support layer may be mono-layer, dual-layer or multi-layer.

(e) Generalized Description of Essential Elements of the Invention

The retroreflective sheetings comprise a monlayer of retroreflective elements supported by and partially embedded in an elastomeric support layer

and protruding from the front side of the support layer, and a reinforcing layer of filaments at least partially embedded in the support layer. In some embodiments, the reinforcing web may protrude from the rear side of the support layer, and in other embodiments it may be substantially completely embedded therein. The reinforcing web is omni-directionally elastic and preferably has high porosity. Examples of webs useful as reinforcing webs in sheetings of the invention include, for instance, knit webs having an open mesh construction or nonwoven webs having a low density construction. By "omni-directionally elastic" it is meant that the article, e.g., reinforcing web. retroreflective sheeting, etc., when subjected to a tensile force can bestretched or extended and tends to return to substantially its original dimensions after release of the elongating tensile force in substantially every direction or orientation instead of only along specific directions or alignment. The support layer, or at least the back stratum thereof is a vulcanizable or curable elastomer which is compatible with the elastomer of the desired substrate, e.g., the side wall of a bicycle, motorcycle, or automobile tire. By "compatible" it is meant that when contacted to the substantially uncured substrate such as in a tire mold and subjected to appropriate conditions of heat and pressure for curing, the vulcanizable portion of the support layer will form a strong bond with the simultaneously curing substrate.

The omni-directionally elastic reinforcing web improves the handling characteristics of the sheeting by imparting greater strength to the retroreflective sheeting,while maintaining the elasticity thereof. For instance,some embodiments of retroreflective sheetings of the invention may

have a break force of about 2.5 pounds (11 Newtons) or more per 3/16 inch (4.8 millimeter) width. Accordingly, the sheeting is better able to withstand the tensile stresses to which it is typically subjected during its fabrication, any necessary conversion, e.g.,cutting to strip form, and assembly with the tire carcass. Another advantage of such webs is that, because of the greater strength imparted to the sheeting, the support layer may be made in thinner form, thereby providing the opportunity for cost savings and overall reduced profile or thickness. In embodiments where the reinforcing web protrudes from the rear side of the support layer, the reinforcing web may also serve to facilitate positioning of the sheeting upon the green tire casing by providing means for a "mechanical tacking" action when the protruding filaments are pressed into the soft uncured tire casing. Furthermore, as discussed above, such protruding webs an also strengthen the ultimate bond between the sheeting and the tire asing.

The retroreflective sheetings typically exhibit high brightness retention when bonded to flexible substrates. For instance, such sheetings may retain at least about 80 percent of their initial retroreflective brightness even after being flexed 200,000 times through cycles of elongation of 30 percent of their unstressed, i.e., relaxed, length and compression for 30 percent of their unstressed length. Thus, such articles as tire sidewalls according to the present invention can retain their desired retroreflective brightness. Also, due in part to the properties imparted to the resultant sheeting by reinforcing webs as described herein, retroreflective sheetings typically exhibit improved abrasion resistance as the retroreflective elements tend to be held more firmly

in the support layer of sheeting, thereby tending to resist dislodgement when the sheeting is subjected to abrasive forces.

The most typical kind of retroreflective elements used in sheetings are transparent microspheres having reflective means on the rear surfaces thereof. Such retroreflective elements typically provide satisfactory levels of retroreflective brightness over a wide range of incidence angles, i.e., the angels at which the light strikes the sheeting, a property sometimes referred to as "angularity". However, retroreflective elements of other configurations may be used.

When microspheres are used as retroreflective elements,the microspheres are preferably substantially spherical in shape in order to provide the most uniform and efficient retroreflection. Typically, the microspheres are preferably substantially transparent so as to minimize the amount of light absorbed by the microspheres and thereby maximize the amount of incident light which is retroreflected by the sheetings. The microspheres which are typically substantially colorless, may be colored such as with dyes or other coloring agents to produce special effects if desired.

Microspheres used in retroreflective sheetings of the invention may be made from glass or synthetic resin having the optical properties and physical characteristics taught herein. Glass microspheres are typically preferred because they typically cost less, are harder, and exhibit superior durability.

The microspheres used typically preferably have an average diameter of between about 40 and about 200 microns, although microspheres having sizes outside this range may be

used in some embodiments. Microspheres which are smaller than this range may tend to provide lower levels of retroreflection cause of diffraction effects, whereas microspheres larger than this range may tend to impart undesirably rough texture to the sheeting or tend to be more readily dislodged by abrasive forces. Microspheres used in the present invention will typically preferably have a refractive index of between about 1.70 and about 2.0, more preferably between about 1.85 and about 1.91, the range typically considered to be useful in microsphere based retroreflective products where the front surfaces of the microspheres are exposed or air-incident. However, microspheres having refractive indices outside this range may be used in accordance with the invention. For instance, microspheres having refractive indices of about 2.3 will provide retroreflection when their front surfaces have water thereon. Accordingly, for embodiments which are t be used under conditions where the front surface of the sheeting is likely to have water thereon, e.g., where the substrate is a rubber raft or flotation device, a mixture of microspheres having refractive indices of about 1.9 and about 2.3 may be used to provide dry and wet retroreflection.

As mentioned above, microsphere-based retroreflective elements of retroreflective sheetings have reflective means on the rear surfaces thereof.

Among the variety of materials which are known for this purpose are vacuum-deposited or vapor-coated metal coatings, such as aluminum or silver; chemically deposited metal coatings, such as silver; metal-coated plastic films; metal flakes, such as aluminum or silver; and dielectric coatings. Aluminum or silver coatings are typically preferred, because they tend to provide the highest retroreflective brightness. The reflective color of silver coatings is typically preferred to that of aluminum coatings, but an aluminum vapor coat is normally more preferred overall, because silver reflective coatings typically tend to suffer more severe and more rapid degradation in outdoor exposure than do aluminum coatings.

The support layer typically comprises a durable polymeric material which forms a flexible, elastomeric layer and preferably provides good adhesion to the other elements of the sheeting, e.g., the retroreflective elements, e.g., glass microspheres with reflective elements, e.g., glass microspheres with aluminum coatings, and the reinforcing web. Illustrative examples of materials which are useful for use in the support layer in many applications of the sheetings are polytetramethylene ether diamine, e.g., having a molecular weight of about 12,000 to about 16,000; HYCAR ATBN, an amine-terminated butadiene acrylonitrile rubber available from B.F. Goodrich Co.; and bis-(3-aminopropl)-polytetrahydrofuran, e.g., having a molecular weight of about 5,000, available from BASF. Such materials are typically used in combination with a hardening material, e.g., an epoxy resin. For instance, the illustrative materials just mentioned may be used in combination with EPON 828, an epoxy resin available from Shell Oil

Company. Support layers of the invention are typically formulated in weight ratios rubber to epoxy of between about 1:1 and about 4:1, and more typically about 2.5:1. Formulations with ratios which are lower than about 1:1 may tend to yield resultant compositions which form layers that tend to be too soft. Other examples of support layer materials which can be used in retroreflective sheetings of the invention include thermoplastic, heat-activated, ultraviolet-cured, and E-beam-cured adhesives or polymer resins.

The support layer should have flexibility, extensivebility, and elasticity properties which are similar to those of the substrate to which the sheeting is to be applied, or at least sufficient to meet the stresses to which the resultant article will likely be subjected. For instance, support layers which are flexible and can return to substantially their original dimensions after being elongated about 50 percent or more will typically be suitable for use on vehicle tires. It may be preferred, however, that embodiments which are to be used on other substrate. Support layers which are not sufficiently flexible, extensible, or elastic to flex, stretch, or recover with the substrate under the conditions of the use of the substrate under the conditions of the use of the substrate may tend to tear or separate from the substrate, to weaken the substrate (e.g., due to displaced or cracked tire rubber) to develop an unsightly appearance, and/or suffer sufficient degradation to impair the desired retroreflective performance of the sheeting, e.g., by dislodgement of retroreflective elements.

The support layer may further comprise a whitening agent, e.g., a pigment, e.g., titanium dioxide, or dye to increase the overall whiteness of the article. Alternatively, it may comprise a coloring agent or combinations of

agents selected to impart a different color thereto, e.g., pigments or dyes which impart yellow, orange, red or other color. In the case of embodiments of the sheeting having dual-layer support layers, such agents are typically used in the binder layer which is usually visible whereas the backing layer often tends to be hidden from view and, accordingly, may be substantially free of coloring agent.

Additionally, the support layer may typically also include one or more weathering agents, stabilizers, ultraviolet absorbers, antioxidants, energy quenchers, reinforcing agents, processing aids (e.g., lubricants, peptizers), hardening agents, adhesion promoters, activators, vulcanizers, platicizers, accelerators, etc. in view of the properties desired for the ultimate application for which it will likely be subjected. In the case of embodiments of the sheeting having multi-layer support layers, such components may be used in one or more of the individual layers therein.

Support layers of sheetings may be multi-layer, i.e., comprise two or more layers. In addition to the aforedescribed back layer and binder layer, there may be a prime layer therebetween or other layer which imparts a desired property to the sheeting.

The retroreflective sheetings comprise a flexible reinforcing web which is omni-directionally elastic and which is at least partially embedded in the support layer and preferably protrudes from the rear side therefrom. As previously defined, by "omni-directionally elastic" it is meant that the web tends to return to substantially its original dimensions after release of a tensile force elongating same in substantially every direction or orientation instead of

only along specific directions or orientations. Omni-directionally elastic, as used herein, does not mean that the elasticity of the reinforcing web is equal in all directions, but does mean that the web may be extended in any direction, preferably at least about 40 percent, and will tend to recover from same. Such webs impart greater strength to the retroreflective sheeting by increasing the strength and maintaining the elasticity thereof, and may strengthen the bond between the sheeting and the substrate. Because of the strength imparted to the overall sheeting by omni-directionally elastic reinforcing webs as taught herein, the thickness of the support layer of retroreflective sheetings adapted to be bonded to vulcanizable or curable substrates may be reduced, thereby permitting cost savings.

Illustrative examples of reinforcing webs used in the sheeting are knit webs (illustrative examples are double knits and circular knits), nonwoven webs (illustrative examples are thermally-bonded, chemically-bonded, spun-bonded, and point-bonded webs) and some woven webs. Such webs tend to provide higher and more uniform extensibility and elastic properties in all directions as compared to woven webs which tend to be bi-directional rather that omni-directional. Knit webs tend to recover more fully substantially without wrinkling after being elongated that do nonwoven webs. However, although some nonwoven webs may tend to wrinkle slightly after repeated elongation and relaxation, nonwoven webs have been found to be more resistant to "necking down", i.e., curling along an axis parallel to the direction of elongation when elongated, particularly in strip form, and may, because they thus tend to retain a more planar profile, be easier to use for

some application. Urethane-based nonwoven webs have been observed to substantially resist wrinkling when repeatedly elongated and released, but tend to provide insufficient strength. It is believed, however, that a urethane-based nonwoven web which would impart greater strength to the sheeting as well as possess the other properties discussed herein could be used in a sheeting.

Woven webs have not been observed to generally exhibit the desired omni-directional elasticity, i.e., they are typically elastic only along the bias. However, a woven web that has the desired omni-directional extensibility properties described herein could be used. For instance, a web woven from spandex filaments would be expected to provide desired omni-directional elasticity, and accordingly could be used herein.

Reinforcing webs used in these sheetings preferably have high porosity such that the support layer material and, in embodiments where the web protrudes from the support layer, the substrate elastomer material flow completely around the filaments of the web such that there are substantially no voids in the finished article, thereby optimizing the adhesion of the reinforcing web to such materials and strengthening the resultant article. Accordingly, it is typically preferred that reinforcing webs used have a weight per square yard of between about 0.3 ounce and about 2.0 ounces.

Reinforcing webs used in the sheetings typically preferably have a grab tensile (breaking) strength in all directions of at least about 9 pounds/inch-width (15 Newtons/centimeter-width). The resulting sheeting typically should have a breaking tensile strength of at least about 15 pounds/inch-width 926

Newtons/centimeter-width) to be conveniently convertible, e.g., slit from bulk sheet form to desired size.

Typically, reinforcing webs used herein preferably have an elongation in all directions of at least about 40, and more preferably at least about 120 percent, depending in part upon the application for which the resultant sheeting is to be used. For instance, on a rubber substrate such as a tire, an elongation in all directions for the resultant sheeting of at least about 40, more preferably 50 percent or more is typically sufficient to prevent cracking.

It is also typically desirable that the thickness of the sheeting be made thin so as to reduce the thickness of the portion of the substrate, (e.g., tire sidewall), which is displaced by the sheeting. Accordingly, it is typically desirable that the individual component layers of the sheeting be thin. Thus, reinforcing webs for use in the sheetings are typically preferably between about 0.002 inch and about 0.01 inch (50 and 250 microns) in thickness. It will be understood, however, that depending in part upon the application for which the resultant sheeting is to be used, reinforcing webs having thicknesses outside this range may be used.

Polyesters, polypropylenes, polyethylenes, nylons, polyamides, celluloses, acetates, fiberglasses, or blends thereof, are illustrative examples of some materials from which webs useful as reinforcing webs may be made. Nylon reinforcing webs are typically preferred because they tend to bond more strongly to the binder material than do polyester or polypropylene reinforcing webs. Some commercially available fabrics which are suitable as reinforcing webs of retroreflective sheetings of the invention include knits, e.g., Type

N35, a denier 1.0 ounce/year^2 nylon fabric from Apex Mills; Type LF2, a 40 denier 1.8 ounce/yard$_2$ polyester fabric also from Apex Mills; and Type 6119, a 20 denier 0.9 ounce/yard$_2$ polyester fabric from L. Travis Textiles; nonwovens, e.g., LUTRABOND 3020, 3135, and 4140, respectively 0.6, 1.0, and 12 ounces/yard, polyamide-6 fabrics from Lutravil Company; spun-bonded fabrics, e.g., CEREX Spunbonded Nylon type 23 Series, a nylon-6, 6 fabric in weights of, e.g., 0.3, 015, 0.6, and 0.7 ounce/yard$_2$ from James River company, and PBN-II, Point-Bonded Nylon Type T30 from James River Company.

One manner of making a retroreflective sheeting for use in the present invention is as follows. Microspheres of the appropriate size and refractive index are cascaded onto a polyethylene-coated carrier, typically precoated with a low adhesion sizing to ensure desired release of the microspheres therefrom, and then partially embedded therein by heating. The microspheres are preferably packed in their closest hexagonal packing arrangement so as to maximize the retroreflective brightness of the resultant sheeting. Reflective means, such as an aluminum vapor coat, is then applied to the exposed portions of the microspheres.

The binder layer is then applied over the protruding microspheres, may optionally be partially cured, e.g., to secure the microspheres in desired orientation, and then the backing layer is then applied over the binder layer. The backing layer may then be partially cured in some instances. The reinforcing web is then applied. The web is typically sunk partially into the backing layer, or even partially into the binder layer and/or additional

amounts of the backing layer material may be applied thereto such that the reinforcing web is at least partially embedded in the support layer. In embodidments where the web protrudes from the rear of the support layer, the filaments of the protruding web are typically coated with a thin amount of elastomer to increase the adhesion of the protruding portion of the web to the substrate upon fabrication of the article.

In the case of the dual-layer support layers, typically the strongest bond between the binder layer and backing layer is embodiments if they are cured at least in part while in contact with one another. Partially curing of the support layer is typically also useful to control the depth to which the reinforcing web becomes embedded in the support layer and to prevent the reinforcing web from sinking too close to, or even into contact with, the retroreflective elements. AT least the back stratum of the support layer, e.g., the backing layer or the portion thereof which comprises the rear side of the support layer, preferably remains in an at least partially uncured state such that when the sheeting is applied to a curable substrate, a strong bond thereto may be obtained. The retroreflective sheeting may be stripped away from the carrier to expose the front surfaces of the microspheres either before or after the sheeting is applied to a desired substrate.

The binder layer and the backing layer, or in the case of a single-layer support layer, the single layer thereof, may be applied in a single coat or in one or more successive coats by known techniques, e.g., extrusion, knife-coating, spraying, etc. for instance, in the case of a single-layer support layer, a first coat may be applied over the retroreflective elements and

partially cured to ensure proper spacing of the subsequently-applied reinforcing web from the retroreflective elements followed by application by one or more subsequent coats of the support layer material. It has been found that typically optimum support and retention of the retroreflective elements by the support layer is achieved when the elements are essentially entirely supported by the support layer and separated from the embedded portion of the reinforcing web by at least a distance equal to one or two times the average size of there retroreflective elements.

5) Description of Production of Embodiment of the Invention

(a) Production of Bicycle Tires

The prior art teaches that the reflective stripe must be placed on the tire sidewall in such a way that the reflective sheeting is applied on a sidewall plan nearly parallel to the wheel plane. The sheeting must not be so close to the tire bead as to be obscured by the wheel rim when viewed at wide entrance angles. The sheeting must not be made so close to the tire tread as to be on raised sidewall ribs where the sheeting will be exposed to excessive scuffing. The prior art teaches that ideal sidewall angle placement is within ±5° of parallel to the wheel plane, i.e., that is remote from the tire tread. The sidewall angle is the angle formed between the vertical axis and the line tangent to the surface of the sheeting on a mounted, inflated tire.

However, according to the present invention, this sheeting is not placed in or on the sidewall remote from the tire tread but is, in fact, placed in or on the sidewall adjacent to the tire tread and/or at the base of the grooves forming the tire treads.

The following ar the procedures for producing the bicycle tire according to the present invention.

The tires should be fabricated using only proven compatible rubber stocks. Normal tire building procedures should be followed through splicing of the tread. The tire rubber should be laid evenly on the fabric, with a minimal variation in thickness, alignment and tread stretch. The sidewall area and/or the base of the grooves forming the treads intended for sheeting application should be uniform and smooth and the tread splice must be as smooth as possible.

Two stripes of the retroreflective sheeting should be placed on the selected area or areas of the tire sidewalls and/or grooves of the treads during a single revolution of the tire carcass. The pressure on the sheeting during this cycle must be great enough to promote good green tack. Stretch introduced into the tire sheeting should be less than 5%. Depending on tread condition and age, a solvent wipe appropriate to the rubber compound used may be necessary for best green tack results.

For best concentricity in the final reflective stripe, the tire building wheel or drum must be rotationally accurate enough to result in a maximum sheeting placement tolerance of ±015 inch (4mm).

The retroreflective sheeting should be hand or automatically cut leaving an overlap splice of approximately 7/8 inch (3mm).

Normal tire shaping and molding procedures should be used. The retroreflective sheeting should not be contaminated with mold release treatments, dust, etc. Tire molds should be cleaned if necessary to prevent

dirt, grime, oil, etc. from being deposited on the retroreflective sheeting. The tire should be placed in the mold as straight as possible and run the cure cycle. The tire should not be stretched or abused while still hot [over 212 degrees F (100 degrees C)]. No material should be applied on the reflective stripe which will affect its reflective performance. Transparent materials, e.g., finishing waxes, silicone, sprays, lacquers, or tire dressings significantly reduce reflective performance.

Adequate packaging and care in shipping the reflective sidewall tires will minimize exposure to dirt and contact migration which may affect reflectivity.

Tire manufacturers must be certain that tires they produce meet all applicable performance standards or specifications of bicycle manufacturers, tire distributors, or government agencies. Reflective tire performance should be monitored as part of formal quality testing program. Reflective performance tests require proper photometric measuring equipment and practices.

Application of such retroreflective sheetings to tires may be achieved by placing a piece of the sheeting of appropriate dimension on the proper location of the unvulcanized or green tire casing, i.e., on the sidewall adjacent the treads and/or at the base of the tread, and then putting this assembly in the tire mold. When sufficient heat and pressure are applied in the tire mold to cure the vulcanizable portion of the sheeting and the tire casing, the sheeting will be embedded in the base of the tire tread of the tire casing, with the vulcanizable portion of the binder layer vulcanizing with the elastomer of the

abase of the tread of the tire such that the sheeting forms a substantially integral part of the tire tread sidewall.

In other embodiments of the invention the article may be provided with the retroreflective beads by the use of a formable material applied to the article. One such formable material is that disclosed and claimed in the United States Patent NO. 4,761,440 patented August 2, 1988 by Pierre Laroches, assigned to Glaverbel. That patent describes a formable polymeric material comprising a synthetic polymer and a filler material. The filler material was comprised of glass beads bearing coatings of at least one specified coating agent. The coatings limited adhesion between the glass beads and the synthetic polymer and conferred an increased impact resistance on an article formed from such filled polymeric material as compared with an article which included uncoated glass beads as filler material but which was otherwise identical.

With proper application and when vulcanized with proper mold temperature on a compatible bicycle tire sidewall, the sheeting is as resistant to abrasion as the adjacent tire material. Simulated wear testing by 100 cyclic strokes with a wet, steel-bristle brush will not remove the stripping from the tire sidewall and a minimum of about 40% of the reflective brilliance will be maintained.

Reasonably quick and accurate placement of the reflective stripe onto green (unvulcanized) tire carcass is important for efficiency in reflective tire production. The stripe applicator must remove the protective liner and

accurately feed the reflective sheeting with minimum tension (less than 5% sheeting stretch) onto the green carcass.

(b) Production of Pet Collars or Pet Leashes

In the case of a pet collar or pet leash which is made of a fabric material which can absorb liquid or viscous materials, a further variant of the invention may be provide din the form of the article which has been coated with a coating composition. One such composition is provided in United States Patent No. 2,574,971 patented November 13, 1951 by Harry Heltzer, assignor Minnesota Mining & Manufacturing Company. That patent describes a quick-drying liquid composition comprising a drying-oil-base varnish containing a brilliantly reflective pigment and additionally containing magnesium silicate pigment adapted to provide a false-body, and a suspended admixture of transparent glass beads.

Another such composition is that disclosed and claimed in United States Patent No. 4,263,381 patented April 12, 1981 by Wallace K. Bingham, assignor to Minnesota Mining and Manufacturing Company. That patent described and claimed a coating composition useful for retroreflectorizing fabrics. The composition included a dilute coating vehicle that includes film-forming binder material and a volatile constituent, as well as transparent microspheres having a refractive index between about 1.85 and 2 hemispherically-coated with specular reflective means and dispersed in the coating vehicle.

6) Conclusion

Thus, the present invention provides an article of manufacture, i.e, a tire, a pet collar or a pet leash, which solves the problem of making a vehicle or a pet visible at night. These articles have been found to be brightly retroreflective a night when illuminated by the headlight beam of a vehicle. Under such retroreflective viewing conditions,, each properly oriented miscrosphere sends back a pinpoint of light, and in the aggregate, the myriad pinpoint reflections make the article bright and visible.

From the foregoing description, one skilled in the art can easily ascertain the essential characteristics of this invention, and without departing from the spirit and scope thereof, can make various changes and modifications of the invention to adopt it to various usages and conditions. Consequently, such changes and modifications are properly, equitably, and "intended" to be, within the full range of equivalence of the following claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:-

1. A bicycle tire having a layer of retroreflective beads permanently adhered onto or into, at least one of the sidewall adjacent the tread portion and the bases of grooves forming the tread portion thereof.

2. The bicycle tire of claim 1 wherein said retroreflective beads are permanently adhered by vulcanization.

3. The bicycle tire of claim 1 wherein said retroreflective beads are permanently adhered by means of rubber adhesion.

4. The bicycle tire of claim 1 wherein said bases of said grooves forming said tread portion of said tire are provided with a sheeting material, said sheeting material having a base amendable to securement to an elastomer by vulcanization, and having another surface provided with durable, exposed, retroreflective beads, the so-provided combination having been subjected to vulcanization, the retroreflective beads thereby being vulcanized onto or into, said bases of said grooves forming said treads.

5. The bicycle tire of claim 1 wherein said bases of said groove forming said tread portion of said tire are provided with an adherent coating of a formable material provided with said retroreflective beads therein, said tire then having been treated to integrate the formable material with said bases tire tread and te sidewall, said reflective beads thereby being vulcanized onto or into, said bases of the grooves forming said tire tread.

6. the bicycle tire of claim 1 wherein said sidewalls of said tire adjacent to said tread portion of said tire are provide with a sheeting material, said sheeting material having a base amendable to securement to an elastomer by vulcanization, and having another surface provided with durable, exposed, retroreflective beads, the so-provide combination having been subject ed to vulcanization, the retroreflective beads thereby being vulcanized on, or into, said sidewalls of said tire adjacent to said treads.

7. The bicycle tire of claim 1 wherein said sidewalls of said tire adjacent to said tread portion of said tire are provided with an adherent coating of a formable material provided with the retroreflective beads therein, said tire then having been treated to integrate the formable material with said sidewalls, said reflective beads thereby being vulcanized onto, or into, said sidewalls of said tire adjacent to said tread.

8. The bicycle tire of claim 1 wherein both said sidewalls of said tire adjacent to said tread and said bases of said grooves forming said tread portion of the tire are provided with a sheeting material, said sheeting material having a base amendable to securement to an elastomer by vulcanization, and having another surface provided with durable, exposed retroreflective beads, the so-provided combination having been subjected to vulcanization, said retroreflective beads thereby being vulcanized onto, or into, both said sidewalls of said tire adjacent to said tread and said bases of said grooves forming said treads.

9. The bicycle tire of claim 1 wherein both said sidewalls of said tire adjacent to said tread and said bases of said grooves forming said tread portion of the tire are provided with an adherent coating of a formable material provided with the retroreflective beads therein, said tire then having been treated to integrate the formable material with said base of said tire tread and with said sidewalls, said reflective beads thereby being vulcanized onto, or into, both said sidewalls of said tire adjacent to said treads and said bases of said grooves forming said tire treads.

10. As an article of manufacture, a collar, leash or harness comprising a base article, either in rectangular cross-section belt form or in circular cross-section cylindrical form, and a layer of retroreflective beads permanently adhered thereto, or blended into, by vulcanization or adhesion, on or in, at least the outer exposed surface of said collar, leash or harness.

11. As an article of manufacture of claim 10 as a pet collar, wherein said collar is in belt form and wherein at least one outer surface of said belt form, the ends of which are provided with clasping means to provide an encircling collar, is provided with retroreflective beads, said beads being permanently adhered onto or into or are blended into, the outer surface of said belt form which provides said pet collar.

12. The pet collar of claim 11 wherein said at least on outer surface of said collar has been modified by the application, to the outer surface thereof, of an adherent coating which is amenable to treatment to provide permanent bonding; wherein a retroreflective bead flexible film has been adhered thereto, said film being a flexible film having a base surface amenable to securement to provide permanent bonding, and whose other surface is provided with durable, exposed, retroreflective beads; and wherein upon completion of the treatment to provide permanent bonding, the retroreflective beads have been permanently bonded onto or into or are blended into the collar.

13. The pet collar of claim 11 wherein at least one outer surface of said collar has been coated with a liquid or viscous coating composition containing the retroreflective beads; and wherein upon completion of the drying of the coating composition, the retroreflective beads have been permanently bonded onto or into or blended into the collar.

14. As an article of manufacture of claim 10 as a pet leash or harness, wherein said pet leash or harness is circular in cross-section and wherein the entire outer surface of said circular in cross-section lease or harness is provided with retroreflective beads which are permanently adhered onto, or into, or are blended into, said surfaces.

15. The pet leash or harness of claim 14 wherein said outer surface of said leash or harness has been modified by the application to the outer surface thereof, of an adherent coating which is amenable to treatment to provide permanent bonding; wherein a retroreflective bead flexible film has been adhered thereto, said film being a flexible film having ab se surface amenable to securement to provide permanent bonding, and whose other surface is provided with durable, exposed, retroreflective beads; and wherein upon completion of the treatment to provide permanent bonding, the retroreflective beads have been permanently bonded onto or into or blended into said leash or harness.

16. The pet leash or harness of claim 14 wherein said outer surface of said leash or harness has been coated with a liquid or viscous coating composition containing the retroreflective beads; and wherein upon completion of the drying of the coating composition, there retroreflective beads have ben permanently bonded onto or into or blended into said collar.

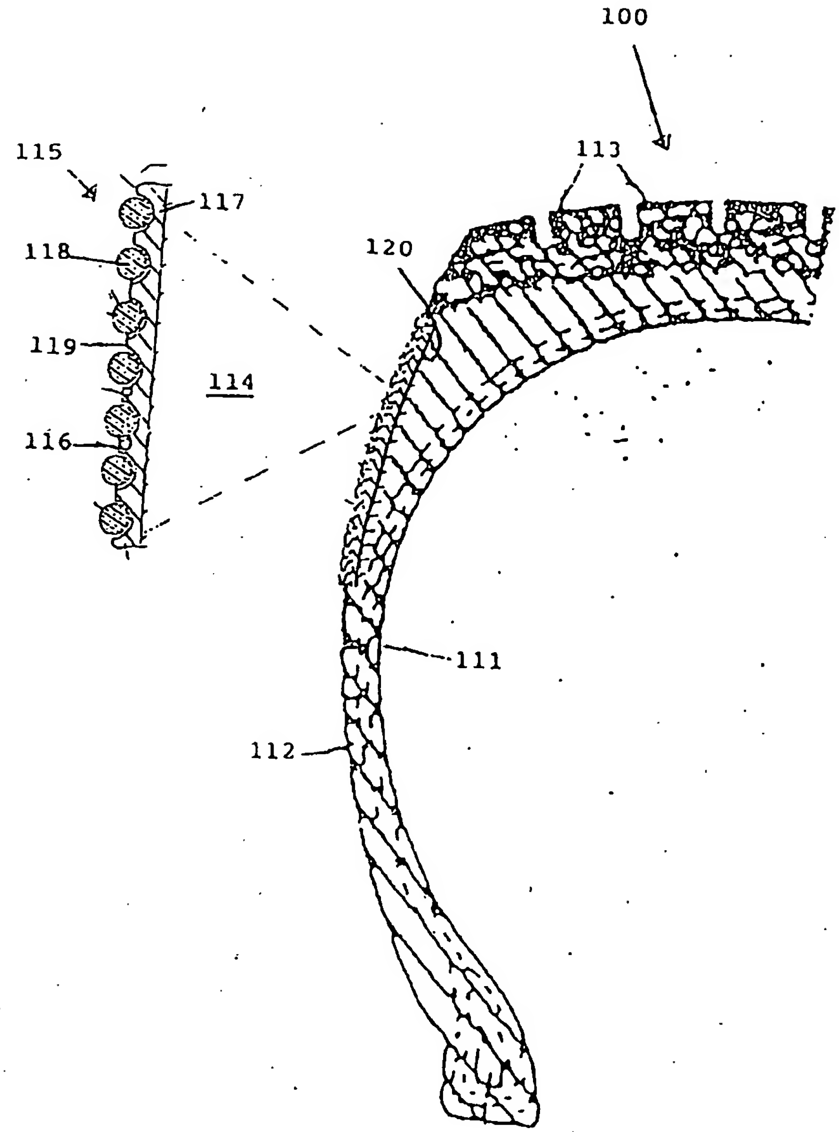


FIG. 1

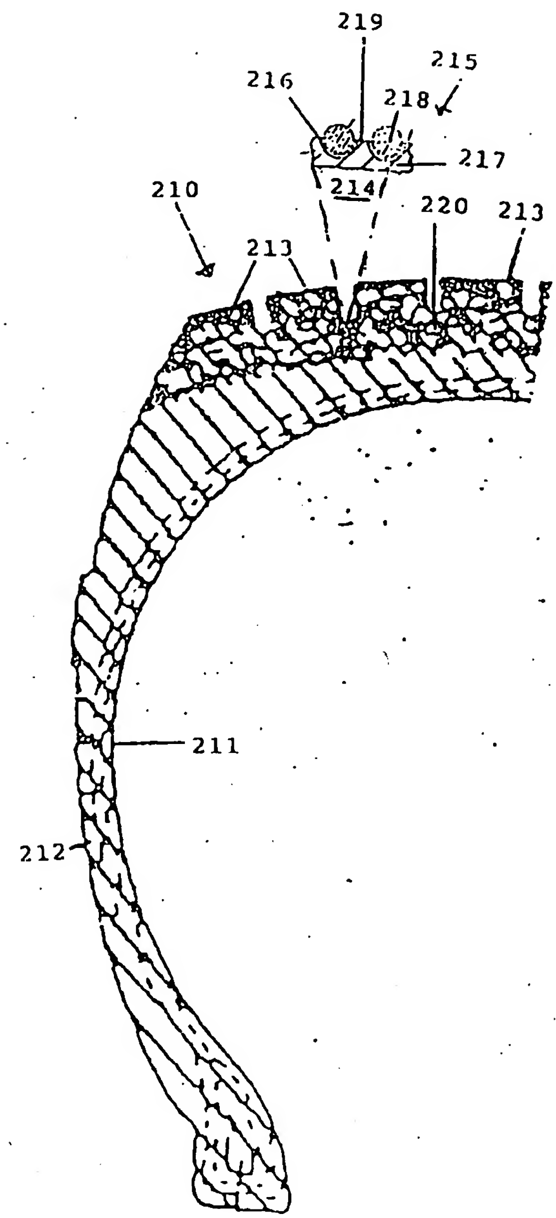


FIG. 2

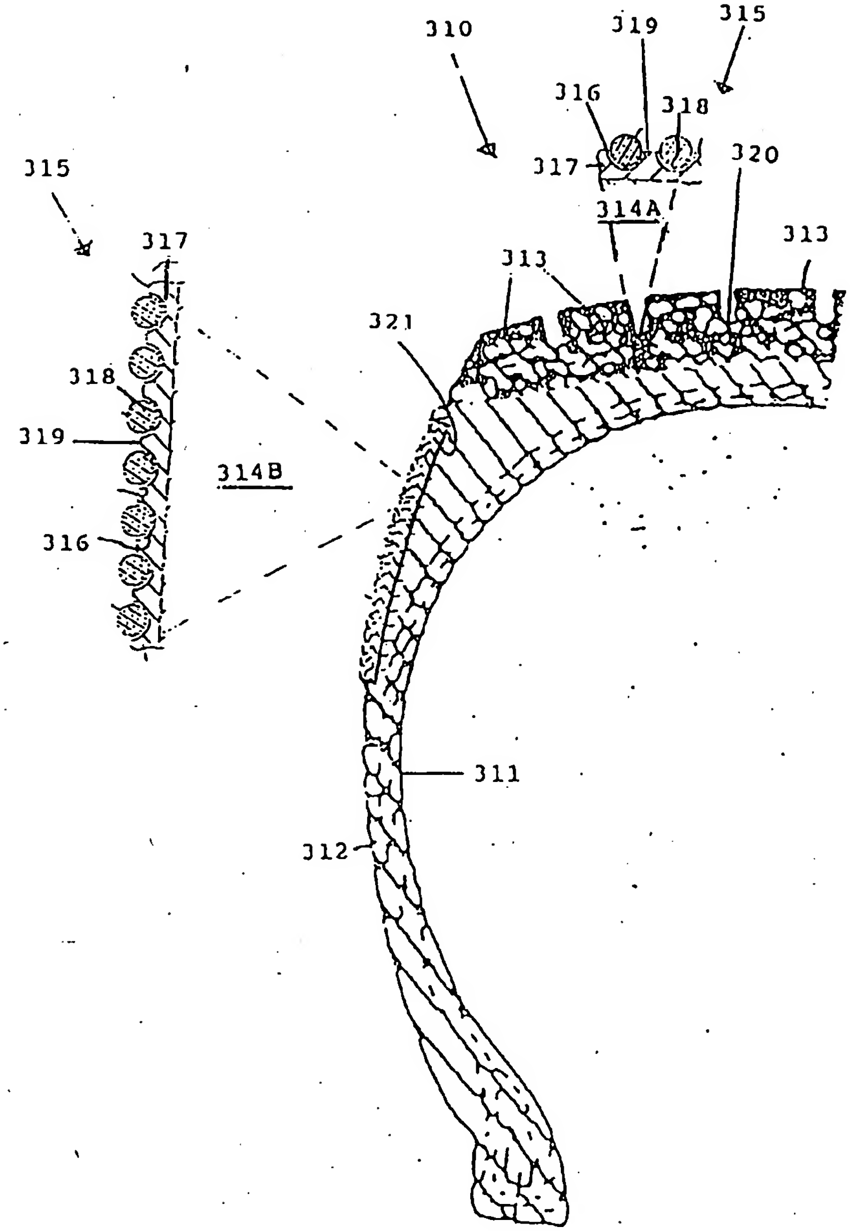

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FIG. 3